

# X-33 Combustion-Wave Ignition System Tested

The NASA Lewis Research Center, in cooperation with Rocketdyne, the Boeing Company, tested a novel rocket engine ignition system, called the combustion-wave ignition system, in its Research Combustion Laboratory. This ignition system greatly simplifies ignition in rocket engines that have a large number of combustors. The particular system tested was designed and fabricated by Rocketdyne for the national experimental spacecraft, X-33, which uses Rocketdyne's aerospike rocket engines.

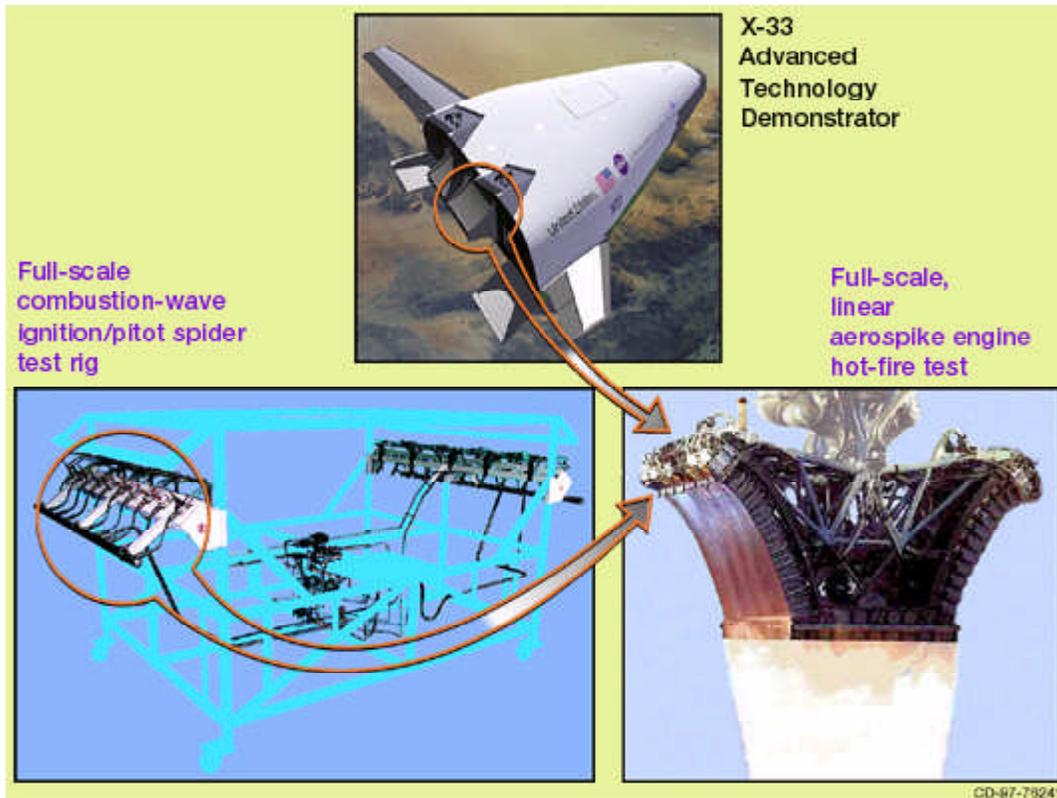
The goal of the tests was to verify the system design and define its operational characteristics. Results will contribute to the eventual successful flight of X-33. Furthermore, the combustion-wave ignition system, after it is better understood and refined on the basis of the test results and, later, flight-proven onboard X-33, could become an important candidate engine ignition system for our Nation's next-generation reusable launch vehicle.

This recent test program successfully proved that the ignition system design is sound. In addition, it identified the operational characteristics of the ignition system that are important to the X-33 vehicle as well as for other future applications.

The program started in 1997, first with a subscale, prototype system that used gaseous propellants, and then with a full-scale, flightlike, prototype system that used liquid hydrogen and oxygen propellants to fully simulate the flight conditions.

The general concept of the combustion-wave ignition system is that it initiates and distributes the flame of its premixed propellants so that they ignite in multiple locations. It has three basic components: a propellant premixer, an ignition device mounted to the premixer, and a number of tubes stemming from the premixer. The premixer mixes the incoming propellants as they flow into the tubes. The tubes are each terminated at a location where ignition is desired (for example, in a combustor). Several considerations need to be taken, however. First, the propellants in the ignition system should be in a gaseous state and well mixed for the flames to propagate successfully. Second, the propellant pressure in the system should be appropriate in order to avoid damage to the system upon flame initiation. Third, the timing should be optimized for propellant priming and flame initiation at the premixer for each unique application of the system.

The combustion-wave ignition system is simple to design and fabricate, and it offers weight savings, decreased electrical power consumption, and a precise and uniform timing for ignition at multiple locations.



*Combustion-wave ignition system testing for the X-33 demonstrator vehicle.*

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